

STATE OF ALASKA

Jay S. Hammond, Governor



Annual Performance Report for

MENDENHALL LAKES
SALMON REARING FACILITY

by

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TABLE OF CONTENTS

	Page No.
ABSTRACT	1
OBJECTIVES	2
TECHNIQUES USED	2
FINDINGS	5
RETURNS	7
FINANCING	13
DISCUSSION	13
LITERATURE CITED	15

RESEARCH PROJECT SEGMENT

State:	Alaska	Name:	Sport Fish Investigations of Alaska
Study No.:	AFS 43	Study Title:	MENDENHALL ANADROMOUS FISH REARING PONDS
Job No.:	AFS 43-3	Job Title:	<u>Pond Rearing of King and Coho Salmon</u>

Period Covered: July 1, 1974 to June 30, 1975.

ABSTRACT

During the first year of experimentation at the Mendenhall Lakes Rearing Facility, a total of 81,425 coho, Oncorhynchus kisutch, smolts were released from Norton and Dredge lakes. A total of 93,129 spring king salmon, O. tshawytscha, smolts were released from Moose Lake. An additional 124,309 king smolts reared at the Crystal Lake Hatchery were released into the outlet of Moose Lake. Percentages of smolt produced from fry planted in Norton and Moose lakes were 45.5 percent and 60.0 percent, respectively. Dredge Lake could not be evaluated because of unknown fish losses during washouts of the outlet dike.

Survival of coho from planting on August 7, 1973 to removal on July 3, 1974, in Norton Lake was 66.9 percent. Survival of king salmon in Moose Lake from planting on September 27, 1973 to removal on August 23, 1974 was 61.7 percent.

A total of 614 coho jacks (precocious males) returned to the facility during fall 1974.

Survival to adult for one, two and three-year-old naturally-produced coho smolts released in 1973 was 5.8 percent, 12.0 percent, and 31.5 percent, respectively.

RECOMMENDATIONS

1. Rearing fish of different origins should be kept separate to isolate different gene pools. By isolation of genetically different stock, studies of survival, time of spawning, and productivity could be made to select the stock of fish best adapted for rearing in Mendenhall Lakes.

2. The feasibility of retaining one-year-old nonsmolt coho for an additional year of rearing should be determined.
3. Statistically valid procedures should be developed for sampling rearing fish populations, catch, and escapement.
4. Use of rearing pens within a lake to improve smolt production should be tested and evaluated.
5. Studies should be initiated to determine: (1) effects on a lake of various aeration techniques, (2) use of rearing fish populations by predatory birds.
6. The project goal of experimental rearing of salmon smolts should be continued through routine maintenance, monitoring and logistics programs as has been done throughout the past year.
7. Feeding of medicated food (e.g., Oregon moist pellet TM50 medicated 1.25 mg/16 of feed) should be done periodically to increase fish resistance to stress.
8. Coded wire tags in conjunction with adipose fin clips should be used to mark fish released from Mendenhall Lakes.
9. Develop techniques which maximize operation efficiency and minimize fish handling at the facility.

OBJECTIVES

1. Determine feasibility of increasing numbers of king and coho salmon available to the saltwater fishery in the Juneau area by pond rearing king and coho salmon.
2. Determine feasibility of pond rearing steelhead and feasibility of enhancing Juneau area steelhead fishing by introducing pond reared steelhead smolts into local streams.
3. Determine feasibility of using adult king and coho salmon returning to Mendenhall Ponds as a reliable source of king and coho eggs.

TECHNIQUES USED

The 1972 brood coho in Norton and Dredge lakes, and the 1972 king in Moose Lake were fed dry pellet feed until freeze-up on November 2, 1973. Fish were fed Oregon moist pellets with oxytetracycline for a two week period prior to freeze-up and from spring breakup until the out-migration period. Food was broadcast from a 12-foot-long aluminum skiff. No feeding was conducted from early November through mid-April when the lakes were covered with ice. Records of amount of feed used were recorded daily.

Fish production was measured in weight gained by the fish. Rearing fish were sampled by placing Gee minnow traps in six locations in a lake. The total weight of fish caught in the six traps was measured by use of a Chatillon circular scale. The fish were counted when released back into the lake. The number of fish per pound was determined by dividing the number of fish into the pounds of fish.

Fish populations in the rearing lakes were maintained through winter by use of aeration systems designed by the Hinde Engineering Co. described by Bethers (1974).

Inclined screen out-migration traps were placed in the outlets of Dredge and Norton lakes and a funnel trap in Moose Lake for enumeration of smolts leaving the lakes. Traps were checked daily and fish were removed daily when found in traps. A 200-foot-long by 15-foot-deep 1/4-inch-mesh seine was used in addition to the out-migrant traps to remove fish from the lakes. A diesel powered 5,000 gallon per minute pump was used to lower the levels of the lakes and to isolate the fish so that all fish could be removed by seining.

Fish were transported from the out-migrant traps and seining locations to the main outlet for release in either a 50 gallon capacity converted chest freezer or a 400 gallon fiberglass tank in the bed of a pickup. Aquarium aerators were used in each container. Each trap load or seine load of fish was sampled prior to release. Individual fish for sample were hand picked and included fish of all sizes within that trap or seine catch. Fish were sacrificed and weight, length and scales were taken. Weights were taken with an Ohaus triple beam balance. Mean length, weight and condition factors were determined. Condition factor was determined by use of the formula.

$$K = \frac{100 \times \text{wt. in grams}}{(\text{length in cm})^3} \quad (\text{Hecht, 1916})$$

The adipose fin was removed from a percentage of both the coho and king smolts raised at and released from the Mendenhall facility. A total of 124,309 1972 brood king smolts raised at Crystal Lake Hatchery were released into the holding pond at the Mendenhall facility for imprinting and release. These fish were held for up to two weeks and forced out of the pond by seining. All of the hatchery-reared king smolts were half-dorsal clipped and comparison of survival and return between pond-reared and hatchery-reared smolts could be made.

The 1973 brood coho fry were planted in Moose Lake on September 16, 1974. They were fed and overwintered as described above.

An in-migrant weir was placed in the main outlet control structure to catch in-migrant king and coho salmon, Dolly Varden, Salvelinus malma, and cutthroat trout, Salmo clarki. Dolly Varden and cutthroat trout caught were released into the Mendenhall River 100 yards upstream from the confluence of the Mendenhall Lakes outlet. Adult coho returning (from 1969, 1970, 1971 brood years and released in spring 1973) to the facility were released into the holding pond for ripening. Gametes were taken from the adults after an approximately 15 day ripening period. The gametes were taken separately and flown to Crystal Lake Hatchery for incubation and hatching. Lengths and scales were taken from spawned adult carcasses. Scales taken from adult coho were mounted on gum cards and impressed in clear acetate. The impressions were read on an Eberbach micro-projector at 100X to determine the freshwater age of the fish. Spawned adult carcasses were distributed along the outlet of the Mendenhall Lakes system.

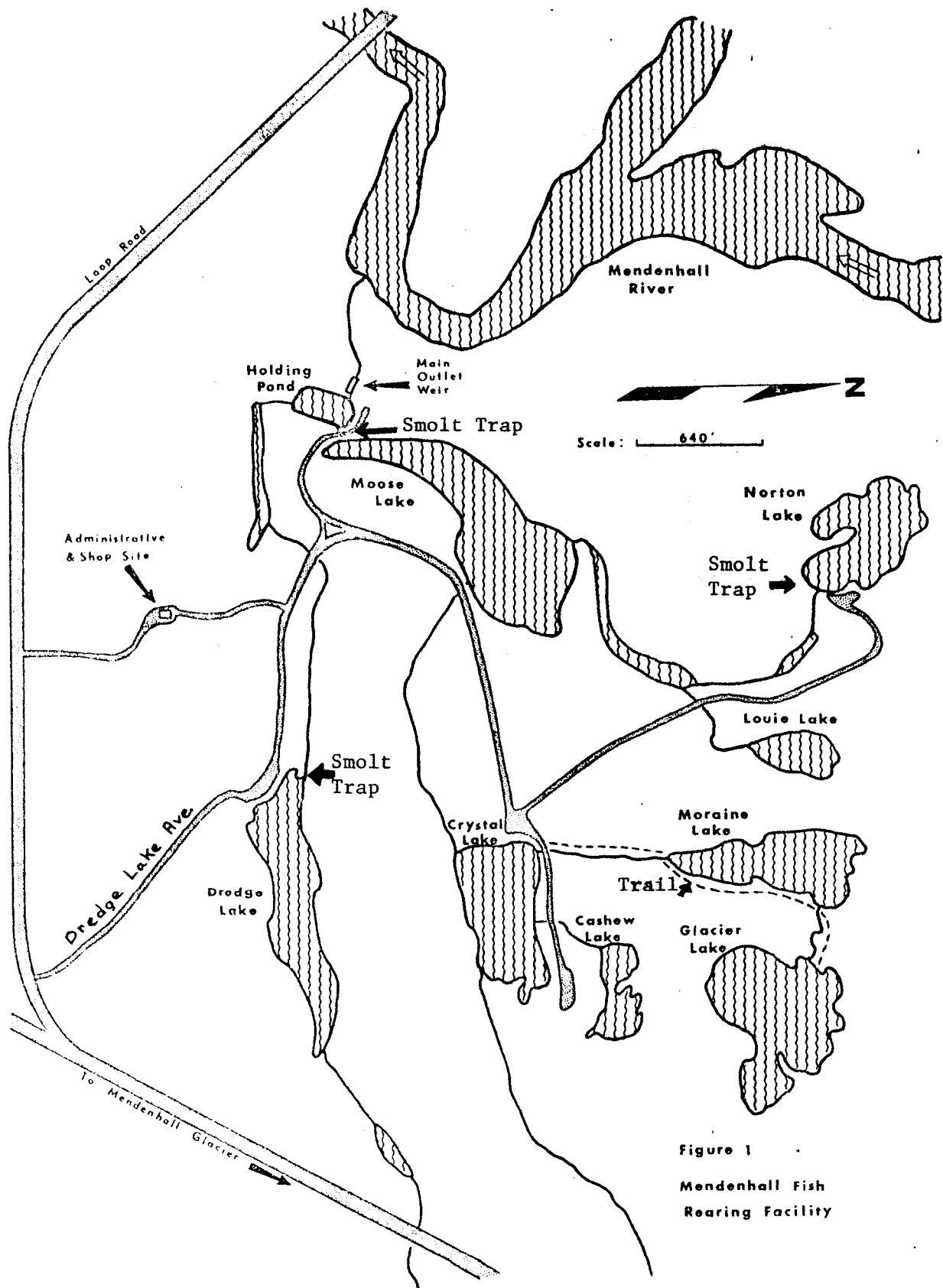


Figure 1
Mendenhall Fish
Rearing Facility

Coho and king salmon jacks (precocious males) returning to the facility were collected for length measurements, scale samples, and fin clip observations. Jack salmon carcasses were given to charitable institutions.

Oxygen readings were taken periodically throughout the rearing cycles with a YSI Model 51A oxygen meter.

FINDINGS

Coho Production, 1972 Brood, Mendenhall and Blind Slough Stock

Norton Lake:

A total of 120,848 1972 brood coho, Oncorhynchus kisutch, fry at 264 per pound were planted in Norton Lake on August 7, 1973. A total of 68,528 coho, of which 54,990 were smolts, were seined from Norton Lake between May 4 and July 3, 1974. By pumping the lake level down and reseining, an additional 12,432 fish were removed. Smolts released ranged from 30 to 60 per pound.

A sample of 67 smolts taken from Norton Lake showed the average fork length and condition factor to be 85.2 mm and 1.045 mm, respectively.

The ratio of smolt produced to fry planted was 80,960/120,848 or 67 percent. Norton Lake coho grew from 264 per pound at planting to 72 per pound on October 6, 1973.

Dredge Lake:

A total of 138,896 1972 brood coho fry at 260 per pound were planted in Dredge Lake on August 7, 1973. From April 28 through June 28, 1974, a total of 26,435 smolt and 9,120 nonsmolt were known to have left the lake. Total smolt production and fish survival could not be determined because undetermined numbers of fish were lost during three washouts of the outlet occurred during the year.

A sample of 118 smolts taken from Dredge Lake showed the average fork length and condition factor to be 91.0 mm and .914 mm, respectively. Dredge Lake coho grew from 260 per pound at planting to 62 per pound on October 6, 1973.

Pathology:

A mid-winter pathology sample of the stocked coho showed:

<u>January 10, 1974</u>	<u>Ave. Length</u>	<u>Ave. Weight</u>	<u>Ave. Condition Factor</u>
Dredge Lake Coho (n=6)	103.0 mm	9.1 gms	.816
Norton Lake Coho (n=6)	103.0 mm	10.9 gms	.962
<u>February 27, 1974</u>			
Dredge Lake Coho (n=6)	73.7 mm	3.9 gms	.969
Norton Lake Coho (n=6)	86.5 mm	6.5 gms	.977

Data taken from winter-trapped fish may not be representative of the populations, but is presented as an indicator of condition of rearing populations.

A pathological examination of six coho from each of the two stocked lakes was conducted on February 27, 1974. Blood smears and kidney smears were observed using light microscopy at 1,000X, and gills were observed directly for gross morphological features with the following results:

Dredge Lake

Blood and kidney-0/6 with visible bacteria.
Gills-6/6 normal.

Norton Lake

Blood-0/6 with visible bacteria.
Kidneys-4/6 with 107-108/ml non-motile straight rods.
Gills-6/6 normal.

Norton Lake coho displayed a high level of bacterial septicemia in the kidney tissues. This condition might be related to low temperature, non-feeding stress.

King Salmon Production, 1972 Brood, Carson River, Washington Stock

A total of 217,438 king salmon smolts were released from the facility in the spring of 1974. Of these, 93,129 had been reared in Moose Lake and 124,307 at Crystal Lake Hatchery.

An additional 2,606 fish were removed from Moose Lake by pumping the lake down and seining. Smolts released averaged 27 per pound. The ratio of smolt produced to fry planted was 93,731/155,078 or 60.0 percent. Total survival of fish in Moose Lake was 95,731/155,078 or 61.7 percent. A total of 39,560 or 42.4 percent of smolts released from Moose Lake were adipose fin clipped.

King salmon smolts from Crystal Lake Hatchery averaged 30.3 per pound at planting. To compare survival of Moose Lake rearing kings to hatchery-reared kings, the hatchery-reared fish were marked with a half dorsal fin clip.

In winter the king salmon in Moose Lake could not be trapped through open aeration leads, even in overnight sets. They were found to inhabit the extreme south end of the lake 50 yards from the nearest aeration lead.

Pathology:

A mid-winter sample for condition of the stocked kings showed:

<u>Date</u>	<u>Ave. Length</u>	<u>Ave. Weight</u>	<u>Ave. Condition Factor</u>
January 11, 1973 (n=6)	67.2 mm	8.8 gms	0.657
February 27, 1973 (n=6)	100.0 mm	8.5 gms	0.832

A pathological examination of six king smolts from Moose Lake was conducted on February 27, 1974. Blood smears and kidney smears were observed using light microscopy at 1,000X and gills were observed directly for gross morphological features with the following results:

Blood-3/6 with 10^4 10^5 /ml non-motile straight rods.
Kidney-2/6 with 10^5 /ml rods as above.
Gills-normal.

A sampling of 109 king salmon released from Moose Lake showed the average length and condition factor to be 108.7 mm and 1.029 mm, respectively.

RETURNS

Coho: 1972 Brood Mendenhall and Blind Slough, Alaska Stock

The first returns from coho smolts released at the Mendenhall Lakes Rearing Facility were jack (precocious male) coho that returned in fall 1974; the same year in which they were released. A total of 614 jack coho, of which 32.0 percent carried adipose fin clips, were trapped in the in-migrant weir. These jacks returned from smolts of which 30.5 percent of the total release was clipped. Average length of clipped jacks was 308.4 mm and average length of non-clipped jacks was 301.6 mm.

Coho jacks all showed typical saltwater growth on scales, and a portion showed false freshwater annuli.

King Salmon: 1972 Brood Carson River, Washington Stock Reared at Moose Lake and Crystal Lake Hatchery

In August 1974, when the pump was set up at Moose Lake for evacuation of water and residual fish, the pump outlet was directed into the Mendenhall River. A total of 15 ripe king salmon jacks were attracted to the pump outwash which varied from three to six C.F.S. of flow. Of these fish, four were from Moose Lake and 11 were from Crystal Lake Hatchery. Of these fish showed no saltwater growth. Evidently these fish had been inhabiting fresh water of the Mendenhall River system since their release.

During October, eight king salmon jacks were collected in the in-migrant weir. Of these fish, one was from Moose Lake and seven were from smolts raised at Crystal Lake Hatchery. Scales of these fish showed no saltwater growth.

Coho: 1973 Brood Mendenhall and Blind Slough, Alaska Stock

Moose Lake:

Moose Lake was the only lake re-stocked with rearing salmon in 1974 because of reasons discussed later in this report.

A total of 209,485 coho were planted in Moose Lake on September 16, 1974. Fish planted were of two different sizes (109,500 @ 183/lb and 99,985 @ 80/lb) and averaged 127 per pound after two days mixing in the lake. The coho in Moose Lake grew from 127 per pound on September 16 to 73 per pound on October 18.

Food conversions made by coho from September 16 to October 18, 1974 were calculated to be:

Total Pounds		Food Conversion		
Fed	Gained	High	Low	Average
2381	1291	1:1.32	1:6.34	1:1.84

Pathology:

A pathological examination of six coho taken from Moose Lake were made on November 19, 1974. Fresh tissue of kidney and spleen from each fish were examined microscopically for bacteria in wet mount and gram stain. A sample of gill tissue was examined microscopically for abnormalities, and fluid from the gill area microscopically in wet mount and gram stain. Kidney and spleen were streaked on five percent Blood Agar (BA) and Tryptic Soy Agar (TSA) for bacterial growth.

Wet mounts and gram stains of fresh tissue from each of the six fish were found free of bacteria. Microscopically the gills were all normal. No bacteria were isolated from the tissues cultured. All six fish appeared to be in good health.

Steelhead:

Steelhead, Salmo gairdneri, fry were not available for rearing during the contract period. Consequently, no work was done on testing the feasibility of rearing steelhead at the Mendenhall Lakes Rearing Facility.

In-Migration, 1973

The first adult coho (from naturally-produced smolts) returning to spawn in Mendenhall Lakes in 1973 were trapped on October 10. A total of 188 adults and 23 jacks (precocious males) were caught in the in-migrant fish weir between October 10 and November 1, 1973. Most in-migrant fish were observed to enter the trap between the hours of 9:00 p.m. and 1:00 a.m.

A total of 188 adults were known to have been released in the holding pond directly upstream from the in-migrant weir. Of these, 155 fish were taken from the pond in three egg takes. Some illegal fishing was known to have occurred, but the extent is not known. Sixty-six females spawned yielded 299,000 eggs. The average fecundity was 3,484 eggs per female.

In-Migration, 1974

The last return of adult coho from naturally-produced Mendenhall Lakes smolts was in October 1974. The in-migrant weir was maintained through November 15 to catch in-migrants entering the holding pond. Accurate in-migrant data is not available because extensive flooding forced temporary removal of the weir on three occasions from October 6 through October 30.

After flood waters subsided, the holding pond was seined and a total of 144 adult coho were found to be in the pond. These fish were retained in the holding pond for ripening and a total of 132 were spawned. The 62 females spawned yielded approximately 186,000 eggs. Twelve fish are known to have escaped the holding pond and entered the Dredge Lake system from October 26 through 30. These fish were allowed to spawn naturally.

Total numbers of fish by species known to have entered the holding pond during fall 1974 were:

Adult coho salmon, <u>Oncorhynchus</u> <u>kisutch</u>	156
Jack coho salmon, <u>O.</u> <u>kisutch</u>	614
Jack king salmon, <u>Oncorhynchus</u> <u>tshawytscha</u>	6
Dolly Varden, <u>Salvelinus</u> <u>malma</u>	871
Cutthroat trout, <u>Salmo</u> <u>clarki</u>	42
Rainbow trout, <u>Salmo</u> <u>gairdneri</u>	3

Natural Production

Adult coho returning in fall 1974 were from smolts which had reared naturally in Mendenhall Lakes before beginning of the rearing project. These smolts were released in spring 1974. This out-migration was evaluated and heavily sampled, as it was the last out-migration of wild coho smolts from the lakes system.

Table 3. Average Length, Weight and Condition Factor by Age Class of Naturally Produced Coho Smolts Released from Mendenhall Lakes in Spring 1973.

<u>Age Class</u>	<u>1 (1971 Brood)</u>	<u>2 (1970 Brood)</u>	<u>(1969 and Earlier)</u>
Total No. (n=365)	193 (52.9%)	168 (46%)	4 (1.1%)
Ave. Length	116.1 mm	127.4 mm	204.3 mm
Ave. Weight	13.7 gm	21.2 gm	91.5 gm
Ave. Cond. Factor	1.016	1.003	.994

Table 4. Number Released, Adult Return, and Survival by Age Class to Adults of Naturally-Produced Coho, Oncorhynchus kisutch, Smolts Released from Mendenhall Ponds in Spring 1973.

	Smolt Released (1)	Adult Return (2)	Survival
<u>Age Class</u>	<u>Age Class</u>	<u>Age Class</u>	<u>Age Class</u>
1 (1971 Brood)	917 (52.9%)	52 (34.5%)	54/917= 5.8%
2 (1970 Brood)	798 (46.0%)	96 (61.3%)	96/798=12.0%
3 (1969 Brood)	19 (1.1%)	6 (4.2%)	6/ 19=31.5%
TOTAL	1,734 (100%)	156 (100%)	

- 1) Expanded from sample of 365 smolts collected.
- 2) Expanded from sample of 119 adult coho.

In addition to the 156 adult coho which returned from this release, 23 jacks returned in fall of 1973. This brings the total return (back to the facility) of the 1973 release to 179/1,734 or 10.3 percent.

Table 5. Freshwater Age Classes and Average Mid-Eye Length by Age Class of Adult Coho Returning to Mendenhall Lakes in 1973 and 1974.

1973 (n=45)			
	<u>Male</u>	<u>Female</u>	<u>Total</u>
	<u>% of Sample</u>	<u>% of Sample</u>	<u>By Age</u>
1 year fresh water	11 (37.9%)	6 (37.5%)	17 (37.8%)
Average length	550.6 mm	599.0 mm	567.7 mm
2 year fresh water	18 (62.1%)	10 (62.5%)	28 (62.2%)
Average length	605.4 mm	648.9 mm	602.9 mm
Total by Sex	29 (64%)	16 (36%)	45 (100%)
Average length	584.6 mm	630.1 mm	601.6 mm

1974 (n=119)			
	<u>Male</u>	<u>Female</u>	<u>Total</u>
	<u>% of Sample</u>	<u>% of Sample</u>	<u>By Age</u>
1 year fresh water	21 (17.6%)	20 (16.8%)	41 (34.4%)
Average length	635.5 mm	599.7 mm	618.0 mm
2 year fresh water	35 (29.4%)	38 (31.9%)	73 (61.3%)
Average length	637.4 mm	618.3 mm	627.5 mm
3 year fresh water	4 (3.4%)	1 (0.9%)	5 (4.2%)
Average length	673.1 mm	584.2 mm	655.3 mm
Total by Sex	60 (50.4%)	59 (49.6%)	119 (100%)
Average length	639.2 mm	611.4 mm	625.4 mm

Table 6. Allocations of Monies Invested in Mendenhall Lakes Rearing Facility Through June 30, 1975

	<u>Total Through 6/30/75</u>	<u>From FY 74 - 75 Budget</u>	<u>Total to Date</u>
Feed	4,530	-0-	4,530
Manpower	20,293	18,327	38,620
Aeration	10,558	-0-	10,558
Trans/mileage	548	6,978	7,526
Rehabilitation	1,113	-0-	1,113
Construction	80,384	5,628	86,012
Commodities	5,309	18,025	23,334
Contract Service	21,048	14,503	35,551
Other Equipment	28,897	1,628	30,525
 TOTAL	 \$172,680	 \$65,089	 \$237,769

As the first 200 smolts trapped and approximately ten percent thereafter were collected, the sample is not equally representative of the entire out-migration. A total of 1,734 smolts were released and 365 (18.2 percent of the out-migration) was collected. The sample was broken into age classes, and average length, weight, and condition factors were calculated for each age class (Table 3).

The number released, adult return and survival by age class of naturally-produced smolts released in 1973 were determined and are presented in Table 4.

The last two returns of naturally-produced coho to the Mendenhall Lakes facility were in the fall of 1973 and 1974. Length and scale data were collected from samples of spawned carcasses. The samples were broken into fresh water age classes by scale analysis, and average length by age and sex class was determined (Table 5).

FINANCING

Funds invested to date at the Mendenhall rearing facility, exclusive of hatchery costs, have totaled \$237,769 (Table 6).

DISCUSSION

In discussion of the feasibility of rearing salmon at the Mendenhall Lakes facility, which is located at 58°24' latitude, one must remember that the growing season is restricted by climate to June through September. Fish growth during winter is nil. In the spring of 1974, the fish were the same size at breakup as they were at the end of the 1973 growing season.

We feel that it is feasible to raise salmon at the facility, because in 1973, when coho were planted in Norton Lake on August 7, we were successful in producing smolt from 54.5 percent of the fry planted. In doing so, only the last half of the growing season was utilized. In 1974, coho fry averaging 100 per pound were planted in Moose Lake on September 7. At freeze-up, these fish had grown to 73 per pound, and approximately 40 percent showed smolt characteristics.

I feel that it is of ultimate importance that rearing fish be re-stocked at the facility as large and as early as possible to maximize use of the short growing season.

The greatest mortality of rearing fish at the facility is due probably to American Mergansers (Harry Senn, Pers. Com.). In the fall, migratory flocks of up to 60 Mergansers have been observed on Moose Lake. During winter 1975, while Moose Lake was covered with ice, Mergansers gained access to rearing fish through narrow aeration leads in the ice.

After smolt removal operations were completed in 1974, we considered Moose Lake, in its present state of development, to be the best adapted for fish rearing and removal. This, and the engineering problems experienced at Norton and Dredge lakes, prompted us to re-stock only Moose Lake in 1974.

In spring 1974, we found that the outflow of Norton Lake was not sufficient for attracting smolts into trapping facilities located in the outlet channel. Also, the outlet channel of Norton Lake would not accomodate outflow of a volume produced by our high capacity pump. Because of the restricting nature of the outlet channel, a large head buildup was necessary in order to force water out the outlet channel. Subsequently, washouts of the outlet dike by water flowing back into Norton Lake were experienced. Because of the logistics necessary to maintain the outlet structures during pumping operations, we considered it unfeasible to continue fish rearing in Norton Lake in its present state of development. With proper development of the outlet channel and dike, Norton Lake could again be used for rearing.

In the Dredge Lake system, we found that the original inlet and outlet control structures were not large enough to allow flow of the volume of water found periodically in the Dredge Lake system. Washouts of the outlet control structure and subsequent fish losses were experienced during the first fish rearing cycle. With inadequate control of water and fish, we decided it was not feasible to continue rearing fish in Dredge Lake in its present state of development. With proper development of inlet and outlet control structures and dikes and a floodwater bypass channel around the lake, Dredge Lake could again be used for fish rearing.

We have determined through two year's experience that we can successfully hold adult coho in the holding pond for ripening. Problems experienced to date have been in the original developement of the facility and not with the fish contained in it.

In the beginning, we had considerable difficulty seining fish from the holding pond because of snags and irregular bottom contours. This problem was corrected in August 1974 when the holding pond was drained and re-shaped with heavy equipment.

Weirs and dikes on both inlets to the holding pond are inadequate. The control structure at Moose Lake outlet washed out in August and October 1974. Flood waters in the Dredge Lake system flooded over the top of the weir and dikes at the holding pond. Adult coho were known to have escaped over the flooded dike in October. We have designed and received approval for construction of new larger weirs and dikes at the outlet of Moose Lake and the Dredge Lake inlet to the holding pond. With these new structures in place, containment of adults in the holding pond can be accomplished and logistics of maintaining the facility will be reduced.

We also plan modification of the trapping facility this summer. By doing so, we can increase trap capacity to 600-1,000 adults and eliminate handling of adults except when testing for ripeness in the holding pond. The original trap facility will hold only 16 to 20 adults before they start to impede on screens, and the trap entrance is difficult for adult salmon to enter.

With the new weirs, dikes, and trap modification discussed above, the serviceability of the Mendenhall holding facility will be increased significantly. The adult king salmon return we expect in the spring of 1977 is going to be very valuable as an egg source; we should have a tried and proved facility in which to hold the adults for ripening. By development of the holding facility this year, we can experiment with holding jack king salmon in 1976 and will be ready for the first adults when they arrive in spring 1977.

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